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(71) Applicant
John Du-Rose Wharton
19, De-Vigier Avenue,
Saffron Walden,
Essex.
(72) Inventor
John Du-Rose Wharton
(74) Agent
Keith W. Nash

(54) **Improvements in and relating to couplings**

(57) A coupling is described (see Figure 1) having part spherical curved end sections (28, 30) which are received in cylindrical passages (16, 22) in two members (10, 20) which are to be joined together by the coupling to provide a continuous passage from one member to the other for the flow of fluid therebetween.

The coupling includes at least one annular crease (32) which extends radially outwardly between the opposed end faces of the two members (10, 20) and axial misalignment vibration and distortion due to temperature changes during use are accommodated by means of the crease (32) which allows considerable relative axial and other movements between the two end sections (28, 30).

In order to improve the seal between the coupling and the two members, the coupling may be subjected to axial compressive loading and to this end the extreme edges of the part spherical end sections are formed with 45° chamfered surfaces which engage complementary 45° inclined surfaces (14, 24) in the members (10, 20) to be joined by the coupling.

The coupling is preferably formed from seamless tubing such as cold drawn seamless steel tube.

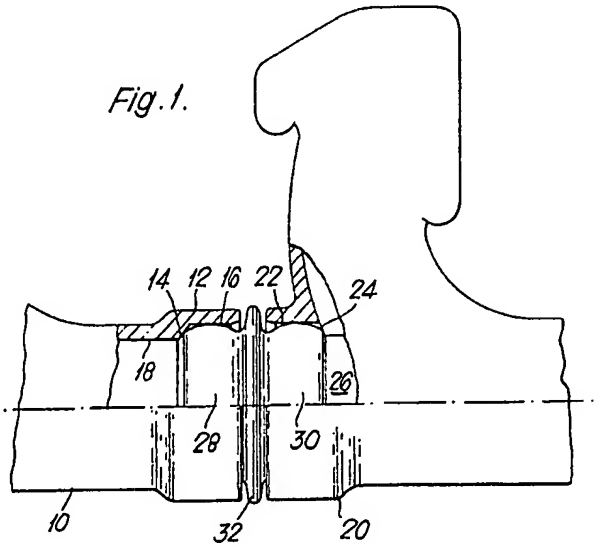

Fig. 1.

The reference to Figure 5 of the drawings in the printed specification is to be treated as omitted under Section 15(2)/(3) of the Patents Act 1977.

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Fig. 1.

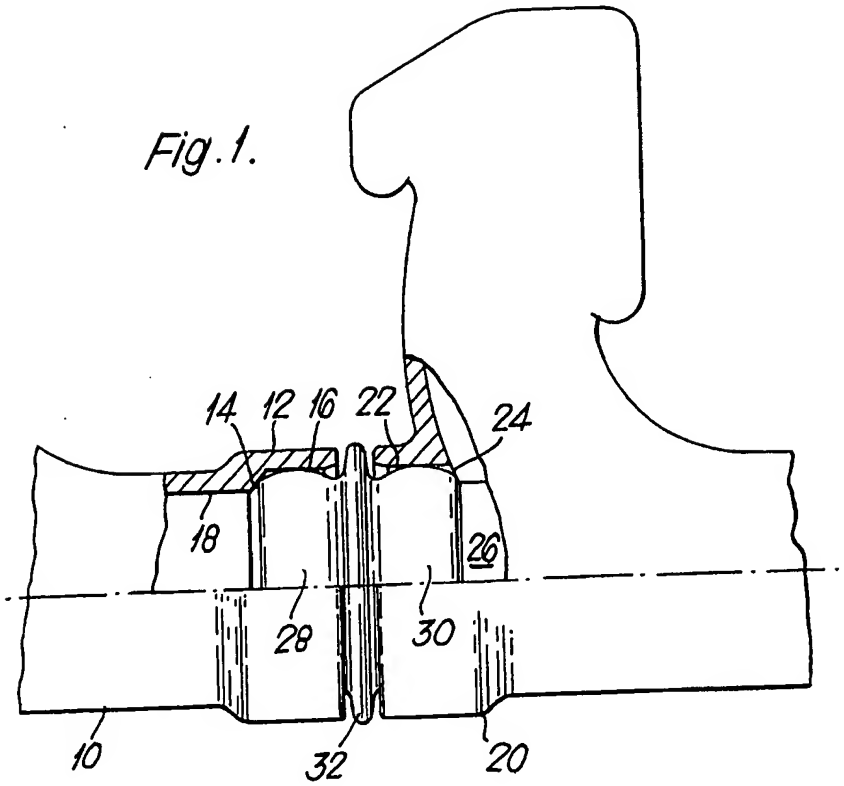


Fig. 2.

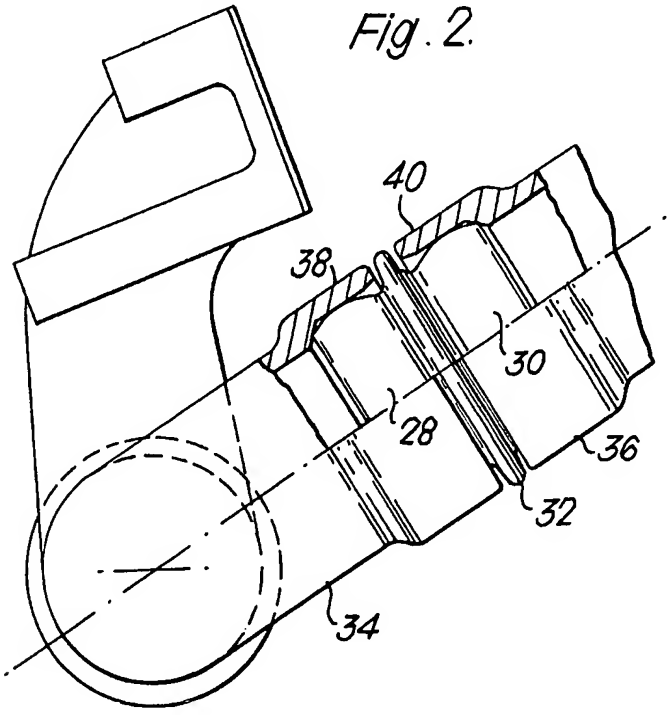


Fig.3.

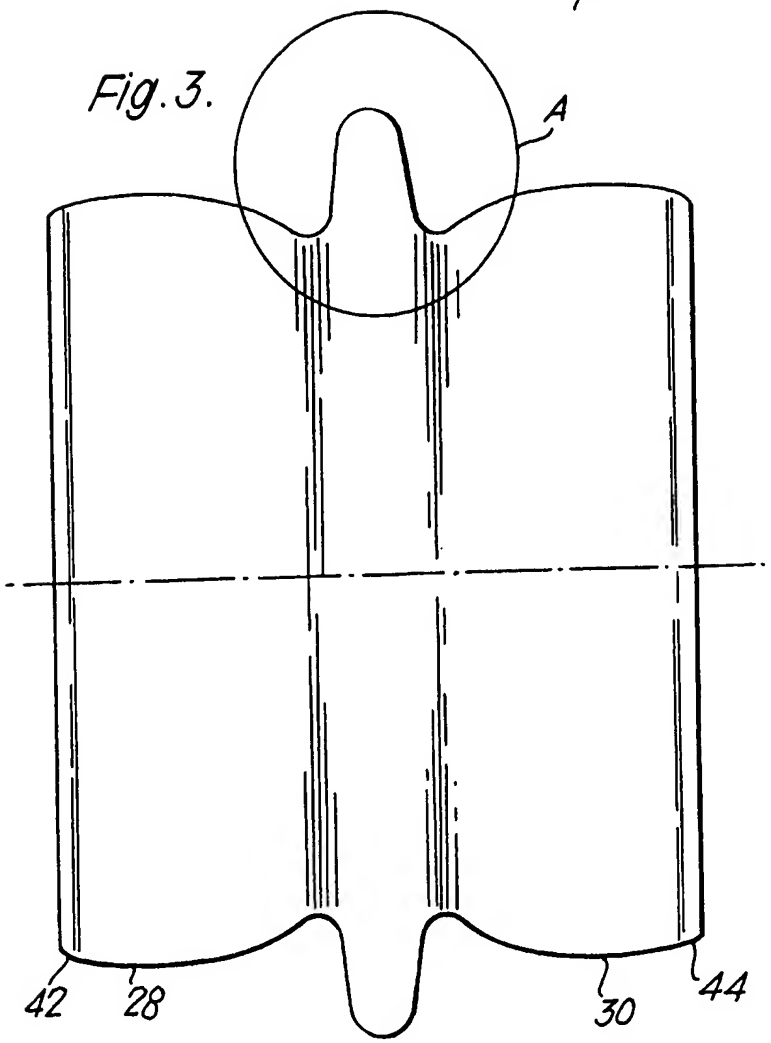
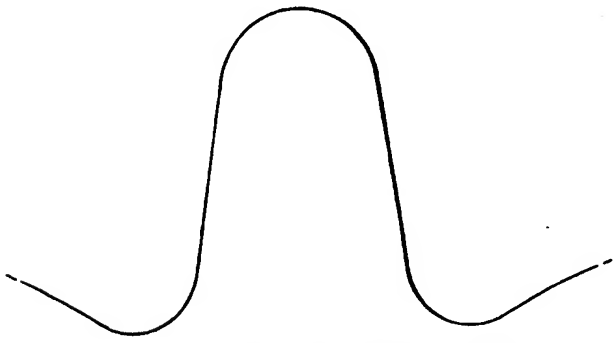


Fig.4.



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SPECIFICATION

Improvements in and relating to couplings

Field of Invention

This invention concerns couplings typically for interconnecting pipes and manifolds and similar devices. In particular the invention is concerned with couplings for joining devices which are or may become misaligned and may be subjected to temperature variations during operation. Couplings of this type will therefore be referred to as compensating couplings.

Background to the Invention

One application of a compensating coupling is the connection of two manifold sections of an internal combustion engine such as a diesel engine. The sections are often misaligned and during operation of the engine vibration and thermal expansion and contraction can cause considerable relative displacement between the different sections. This example clearly demonstrates all of the problems usually encountered with interconnecting couplings, and the gas-tight sealing of manifold sections has always hitherto represented a considerable problem. Although described with reference to a manifold coupling it is to be understood that the invention is not limited to such couplings.

Objects of the Invention

It is an object of the present invention to provide a compensating coupling which will serve as a guide for gases between one device and another.

It is an object of certain aspects of the invention to provide a compensating coupling which will not only contend with dimensional variations and misalignment between connected devices but will compensate for expansion and contraction of the connected devices.

It is another object of one embodiment of the present invention to provide a compensating coupling which can be fitted to internal combustion engine manifolds and manifold sections in such a way as to require no modification of the said existing manifolds or manifold sections and to be interchangeable with the existing cast iron sleeves which have hitherto been incorporated for coupling manifolds and manifold sections together.

Statement of the Invention and description of preferred features

For joining together passages in two members the invention provides a compensating coupling which comprises a first tubular section having a part spherical external shape, a second tubular section aligned with the first tubular section and also having a part spherical external shape, the two said tubular sections being joined by an integral tubular section the wall of which is radially deformed to constitute one or more annular creases or annular bellows to permit at least relative axial movement between the said first and second tubular sections, the said first and second tubular sections being dimensioned to fit as a gas-tight fit within the two passages in the two members.

A coupling as just described will be referred to as a coupling of the first type.

By forming at least the radial deformation in the centre section of the coupling in accordance with the tube configurating process described in British Patent Specification 1253344 so it is found that the first and second tubular sections can not only move relatively axially but also possess a degree of relative radial movement thereby allowing considerable misalignment between the two passages in the two members joined by the coupling. Such misalignment may be static due to initial setting-up inaccuracies, due to vibration during operation for example of a machine to which the members are fitted or of which the members form a part, or due to thermal distortion.

According to a preferred feature of the invention the annular ends of the first and second tubular sections are formed with a 45° chamfered end face and the passages into which the first and second tubular sections are adapted to fit are preferably formed internally with cooperating 45° shoulders to allow the coupling to be axially compressed during initial setting-up, the stresses on the coupling being exerted across the 45° mating surfaces and the sealing contact being maintained between the external circular periphery of the part spherical surface of each of the first and second tubular sections and the passages in the same members into which they are fitted.

Where the passages in the two members which are to be joined by the coupling are of different diameter so the spherical tubular sections are also of appropriate different diameters to allow them to be accommodated within the two different diameter passages in the said members to be joined.

Where a coupling is required to join together two tubes which typically contain gases at a pressure below the air pressure external to the tubes, the invention provides an alternative coupling.

Such an alternative design of compensating coupling comprises a first tubular section the interior surface of which includes a narrowing in diameter along the axis thereof followed by a widening of the diameter, the narrowing and widening following a smooth curved path when viewed in cross-section, a second similar tubular section having a similar internal surface (the two tubular sections being adapted to receive respectively the two tubes to be joined) and an intermediate integral tubular section joining the said first and second sections, the wall section of the intermediate section being radially deformed to form at least one annular crease or annular bellows to permit at least axial movement between the said first and second sections.

The narrowing of the diameter of the said first and second sections of this alternative form of coupling reduces the internal diameter of the said first and second tubular sections such that each is a gas-tight fit on the respective tube introduced thereinto.

A coupling as just described will be referred to as a coupling of the second type.

In a further alternative embodiment, where the

opposed ends of the two members to be joined and/or the passages therein (or the external surfaces thereof) are unsuitable to accommodate a compensating coupling of the first (or second) type, extension pieces may be provided if space permits, each adapted to be bolted or otherwise secured to one of the ends of the members to which the coupling is to be joined, each of the extension pieces including a tubular section adapted to be fitted around or inside the compensating coupling depending upon whether it is of the first or second type and/or for example whether or not positive or negative pressure exists within the said members and coupling when in use.

A first type of coupling incorporating the invention is capable of being fitted into a large number of different environments and in one arrangement where the radial crease extends radially outwardly considerably beyond the radial extent of the part spherical first and second tubular sections of the coupling, the radial crease can be used to axially locate the coupling between two members which otherwise abut, by providing an annular recess in one or both of the members into which the annular radial crease in the section joining the two tubular sections together, can fit, so as to axially locate the coupling in the two members.

Alternatively an axial gap may be provided between what would otherwise be the abutting ends of two members by providing spacers or appropriate abutments on one or both of the members so as to stop the two faces making contact when clamped together and as with the previously described arrangement (and providing the radial extent of the annular crease is sufficient), the location of the latter between the two end faces of the said members, otherwise spaced apart, is sufficient to axially locate the coupling.

In situations in which the coupling is to be subjected to an axial load, it has been found that the 45° chamfer on the annular end surfaces of the coupling stabilises the part spherical tubular sections and prevents deformation or metal flow under axial compression.

A preferred material for a temperature compensating coupling to be used for joining manifold sections of for example a diesel engine is cold drawn seamless steel tube to BS980. 16 swg (0.064") thickness tube has been found to be suitable and the formation of the radial annular crease is achieved using the method of tube configuring described in British Patent Specification 1253344.

The fit between the part spherical section of each coupling and the member into which the part spherical end fits must be such as to provide a gas-tight seal therebetween at all operating temperatures. To this end, it has been found that where temperatures rise during use, a tight fit is needed when cold and this is best achieved by forming the part spherical ends of the coupling with an outside diameter which is substantially the same as the diameter of the passages into which the end is to be fitted, and driving the coupling into the passage using a mallet or hammer.

A particular advantage of using mild steel for temperature compensating couplings to be used in joining manifolds or manifold sections of internal combustion engines or diesel engines arises from the fact that mild steel has a greater coefficient of expansion than cast iron. It is thus possible for a coupling which is sufficiently loose when cold as to allow the coupling to be rotated in the aligned passages in the members into which the coupling is fitted, nevertheless to constitute a good gas-tight seal at elevated operating temperatures since the mild steel will expand considerably more than the cast iron from which the manifold and manifold sections are formed, thus causing the part spherical tubular sections to expand into tight close-fitting contact with the apertures into which they are fitted.

The invention will now be described by way of example with reference to the accompanying drawings.

List of Figures in the drawings

Figure 1 is a cross-section through a joint between front and rear manifolds which are to be joined by a coupling of the first type embodying the invention.

Figure 2 is a cross-section through a junction between a rear manifold and a turbo-charger manifold showing an alternative mode of use of a temperature compensating coupling embodying the invention,

Figure 3 is a side view of a temperature compensating coupling of a type incorporated in Figures 1 and 2,

Figure 4 is a diagrammatic cross-section of the outer surface of the coupling shown in Figure 3 drawn to an enlarged scale showing the detail of the dimensions of the annular crease formed in the intermediate section between the two tubular sections of the coupling and ringed in Figure 3 by the circle A, and

Figure 5 is a cross-section through a join between two pipes joined by a coupling of the second type also embodying the invention.

Detailed description of drawings

Referring first of all to Figure 1, the rear end of a front manifold 10 is formed with an annular enlarged diameter end 12 which includes a 45° machined shoulder 14 and a machined internal cylindrical interior 16, the shoulder 14 joining the machined section 16 to the interior of the manifold designated by reference numeral 18.

The front manifold is joined to a rear manifold generally designated 20 which includes a corresponding circular aperture generally aligned with the machined aperture 16. The internal surface of the circular aperture in the rear manifold 20 is also machined and is designated by reference numeral 22. A 45° shoulder is also formed within the rear manifold generally designated by reference numeral 24 and this serves to join the machined section 22 to the interior of the rear manifold designated by reference numeral 26.

The front and rear manifolds are joined by means of a temperature compensating coupling having a first part spherical tubular section 28 the external diameter of which is such that the circular external surface is an interference fit and forms a gas-tight seal with the internal machined surface 16 and a second tubular section also having an external part

spherical surface 30 the diameter of which is such that this part spherical surface is an interference fit within the machined section 22 and forms a gas-tight seal therewith.

The two tubular sections of the coupling are joined by an intermediate section formed with an annular radial crease 32 formed by a tube configuring process on thin walled tubes as described in British Patent Specification 1253344.

Matching 45° chamfers are formed (although not shown in detail in Figure 1) on the annular ends of the two part spherical tubular sections 28 and 30 to cooperate with the 45° shoulders 14 and 24 in the front and rear manifolds 10 and 20 respectively.

Axially clamping the two manifolds together across the join brings the two 45° shoulders into contact with the 45° chamfers and introduces an axial loading across the coupling and the gas-tight fit between the spherical surfaces on the sections 28 and 30 with the machined interiors 16 and 20 produces a gas-tight join between the two manifold sections which cannot be destroyed by vibration or subsequent temperature variation of one part relative to the other or of the whole assembly in use.

Figure 2 shows an alternative use for a coupling similar to that shown in Figure 1 where the coupling serves to join a rear manifold designated by reference numeral 34 to a turbo-charger manifold generally designated 36. In this case both of the manifolds include enlarged diameter annular sleeves 38 and 40 which accommodate within their machined interiors the part spherical tubular sections 28 and 30 (see Figure 1) of a temperature compensating coupling constructed in accordance with the invention and including an annular radial crease 32 which fits between the opposed ends of the two increase diameter annular sleeve sections 38 and 40 of the two manifold sections.

Figure 3 shows in greater detail the design and construction of one particular coupling although it is to be understood that on this and the other figures in the drawings are only exemplary of one particular embodiment of the invention and the invention is by no means limited to or dimensions of coupling or members to which the coupling is to be fitted.

As shown in Figure 2 the coupling includes tubular sections having part spherical external form 28 and 30 and the annular radial crease which is formed so that the crease extends in a radially outward direction is formed by the tube configuring process described in British Patent Specification 1253344 so as to produce a crease approximately 0.26" in axial extent and of sufficient overall diameter relative to the diameters of the part spherical tubular ends 28 and 30 as to allow the coupling to be axially located between opposed ends of two members (not shown in Figure 3) into which the part spherical tubular ends 28 and 30 are fitted.

Figure 4 shows to an enlarged scale detail of the external form of the configurated tube after working either process described in British Patent Specification 1253344 to produce a preferred form of crease and also shows the preferred shape of the crease so as to allow relative radial and axial displacement of the one section 28 relative to the other section 30 to absorb vibration and misalignment during setting-up.

Figure 3 also shows the 45° chamfers at 42 and 44 on the annular ends of the two tubular sections 28 and 30. The 45° chamfer is found in practice to be of importance where an axial load is to be applied to the coupling so as to stabilise the ends of the coupling and allow thrust to be exerted on the coupling in an axial sense without deformation and metal flow.

Figure 4 is a cross-section through a second type of coupling joining two tubes which are designated by reference numerals 46 and 48. This second type of coupling comprises two end sections generally designated 50 and 52 respectively each of which is of similar form to the other and comprises a generally tubular section at least the inside surface of which reduces in diameter from the entrance to the tubular section in a sweeping curve. The curve flattens out at approximately halfway along the axial extent of each of the tubular sections 50 and 52 and thereafter the diameter increases again so as to define a further smooth curved surface at least inside the coupling as denoted by reference numeral 54 in the case of the section 50 and 56 in the case of the section 52.

The central section which joins the two end sections 50 and 52 together is formed with a radially inwardly directed annular creased 58 which is formed in the tube by means of a tube configuring process as described in British Patent Specification 1253344.

The minimum diameter in each of the end sections 50 and 52 corresponds to the external diameter of the two tubes 46 and 48 respectively which are to be fitted into the two end sections 50 and 52 so that the two tubes are in interference fit within the two tubular sections 50 and 52 and form a gas-tight seal therewith.

The coupling shown in Figure 5 is particularly suited for use in low pressure installations where the pressure within the tubes 46 and 48 which are joined by the coupling is less than the pressure outside the tubes. A negative pressure gradient therefore exists across the seal between the coupling and the tubes 46 and 48 and by virtue of the design of the fit between the coupling and the tubes the result is that the coupling is effectively self-sealing.

By forming at least the central section of the coupling shown in Figure 5 from cold drawn seamless steel tube typically stainless steel of appropriate thickness to the environment into which the coupling is to be fitted, it is found that misalignment of the two tubes 46 and 48 or vibration between the two tubes in use or distortion due to temperature differentials will be accommodated by means of the crease or bellows 58 which will allow axial and other relative movements between the two tubes and will still maintain the seal therebetween.

The coupling may be formed from any suitable material and depending on the application this may comprise cold drawn seamless steel tube or copper or brass or aluminium.

CLAIMS

1. A compensating coupling for joining together

passages in two members, comprising a first tubular section having a part spherical external shape, a second tubular section aligned with the first tubular section and also having a part spherical external shape, the two said tubular sections being joined by an integral tubular section the wall of which is radially deformed to constitute one or more annular creases or annular bellows to permit at least relative axial movement between the said first and second tubular sections, the said first and second tubular sections being dimensioned to fit as a gas-tight fit within the two passages in the two members.

2. A compensating coupling as claimed in claim 1 in which at least the radial deformation in the central section of the coupling is formed by configurating a tube from which the coupling is to be formed.

3. A coupling as claimed in claim 1 or 2 in which the annular ends of the first and second tubular sections are formed with a 45° chamfered end face to cooperate with corresponding 45° surfaces within the members to be joined by the coupling.

4. A coupling as claimed in claim 3 when fitted between two members in which the coupling is subjected to axial compressive thrust transmitted to the coupling across the 45° end faces thereof.

5. A coupling as claimed in any of the preceding claims in which the passages in the two members which are to be joined are of the same diameter.

6. A coupling as claimed in any of claims 1 to 4 in which the passages in the two members which are to be joined are of different diameter and the spherical tubular sections are of appropriate different diameters to allow them to be accommodated in the two different diameter passages of the said members.

7. A compensating coupling constructed arranged and adapted to operate substantially as herein described with reference to and as illustrated in Figure 1 to 4 of the accompanying drawings.

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